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A DECADE OF HIGHWAY CONSTRUCTION
IN COMMUNIST CHINA

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A DECADE OF HIGHWAY CONSTRUCTION
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The following are full translations of selected articles from the Chinese Communist semi-monthly periodical Kung-lu (Highways), Numbers 10 and 11, September 1959.⁷

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TEN YEARS OF ACHIEVEMENTS IN HIGHWAY CONSTRUCTION

[This is a translation of an article written by T'ang Chantung (Chief, Highway Department, Central Highway Bureau, Ministry of Communications), which appears in Kung-lu (Highway), No 10, 5 Sep 59, pp 6-8.]

I

The great Chinese People's Republic has been in existence for 10 years. During that time, the people's highway construction enterprise achieved a rate of flying development under the correct leadership and deep concern of the Central Committee of the Party and Chairman Mao, and with the active participation and enthusiastic support of the people of the entire country.

In order to rule and oppress the people and to carry out the counter-revolutionary war, the reactionary ruling classes constructed the first highway in 1913. It ran from Chang-sha to Siangtan. Up to the end of 1948, that is in over a period of 36 years, they had only constructed 130,000 kilometers of highways throughout the country.

Most of these were of poor quality, and were not surfaced. The bridges were not strong, and the ferry services were crude. And, there were no unified engineering and technical standards. No roads were built to obtain access to the extensive areas in the northwest and the southwest, which are inhabited by the national minorities, nor into the major portions of the mountain areas.

In addition, along the extensive coastline of the motherland in the southeast and on the western frontiers, not very many roads were constructed which could provide communications and defense facilities. And most of these highways were not kept regularly in good repair, so that as time passed they became neglected, and travel over them was uncomfortable, and in rainy weather it was very muddy. On the eve of the liberation in 1949, when the Kuomintang forces retreated in disorder, they carried out extensive destruction of the highways, and at that time only 75,000 kilometers of highways were open to traffic in all of the country.

After liberation, during the three year period given to restoration of the economy, the original highways were rapidly overhauled and improved, and the bridges were strengthened.

During the period of the First Five-Year Plan, we constructed large numbers of highways in the national minority areas in accordance with Chairman Mao's directive, "In Order to Help our Fraternal Nationalities, We Must Not Fear Difficulties and We Must Exert Efforts in Road Construction." Those constructed include the Sikang-Tibet, Tsinghai-Tibet and Sinkiang-Tibet highways on the plateau areas more than 4,000 feet above sea level, which is known as the "Roof of the World" and the Ch'eng-A Highway, the Kun-Lo Highway, and Hainan Highway, and the highways in the multi-nationality areas of the provinces of Yunnan and Kweichow.

In 1950, the American imperialists launched the war of aggression in Korea and fostered the pirate like acts of Chiang Kai-shek which were aimed at sabotaging our coastal areas. In order to meet the needs of national defense, we constructed many national defense highways in such areas as the Liaotung Peninsula, the Shantung Peninsula, the Fukien front, and on Hainan. This effectively supported the needs of the "Resist the United States and aid-Korea campaign", repulsed attacks from the outside, and consolidation of the national defense.

The Central Committee of the Party is extremely concerned over the restoration and development of the economy of the old revolutionary bases and mountain areas. In order to develop the resources of the mountain areas and to improve the living conditions of the people there, we exerted great efforts in the building of various kinds of roads to the cities and towns in the old revolutionary bases previously not accessible to highways and roads leading to the mountain areas.

In 1955 China announced the 40-Article Agricultural Development Program and this was followed by the high tide of the socialist transformation of the rural areas and the cooperativization of agriculture, and the bumper harvest in 1956. This greatly stimulated the activism of the peasants in the construction of roads, and in all parts of the country there appeared the first mass movement for road construction. As a result, large numbers of simple highways were built, and by the end of 1957, the country had 250,000 kilometers of highways open to traffic.

In 1958, when China entered the Second Five-Year Plan,

economic construction in the country developed rapidly. This was particularly true when the Central Committee of the Party brought forward the slogan of paying special attention to the development of the steel industry.

Spurred on by the situation arising from the overall leap forward in industrial and agricultural production, the country saw an unprecedented high tide in the movement for road construction by the masses. This was undertaken in order to facilitate the mining of coal and the refining of iron and steel, to promote agricultural and subsidiary production in the rural areas, and to encourage the interflow of supplies between urban and rural areas. In the period of about a year, the whole country built 150,000 kilometers of new roads (of which about 140,000 kilometers are simple highways), and renovated more than 40,000 kilometers. Up to this time, more than 400,000 kilometers of highways in the country are open to traffic, an increase of over 400 percent compared to the early stage following liberation.

In addition, over the extensive mountain regions and plains, we have also constructed large numbers of animal paths, large paths for carts, trams and roads with chain guard rails. These were linked with railways, navigation routes and trunk lines of highways to form local communication networks of a considerable scope and reaching in all directions.

Along the two sides of the hundreds of thousands of kilometers of highways, we have strenuously carried out the planting of trees. In many sections of the highways, the trees have grown luxuriantly and are providing extensive shade to pedestrians and vehicles; affording both beauty and comfort.

The highways of new China have not only increased in quantity, but have also been greatly improved in quality. During the past 10 years, highways have been improved through the utilization of locally supplied materials, including the addition of more layers of gravel, more layers of protective materials, reduction of curves, and the decreasing of steep gradients, and the reduction of ferries by increasing the number of bridges.

The appearance of the highways has also undergone a marked change. Measures of local expediency have been used for the strengthening of regular maintenance so that on the trunk lines, generally a speed of about 40 kilometers per hour may be used. This has effectively supported the development

by the highway transport industry of the following two large scale mass movements: the first for "Safety, the four stabilities, and the achievement of a monthly turnover of 2000 ton-kilometers per vehicle"; and the second for "Safety and economy, and the achievement of a monthly turnover of 10,000 ton-kilometers for each vehicle-ton unit. Thus, transport costs have been lowered, and industrial and agricultural production and the interflow of supplies between urban and rural areas have been promoted.

We have also improved the distribution of highways over the extensive territory of the country. A great change has come to such national minority areas as Tibet, Tsinghai, Sinkiang and Inner Mongolia and the broad mountain areas. During the period immediately following liberation, about one-third of the hsien cities of the whole country (not including Tibet) were not accessible by highway. Today, the inaccessible parts have been reduced to 45 percent /of the formerly inaccessible areas/.

Whereever a highway reaches, a new atmosphere appears as economic conditions are greatly improved and prices of native and special products enjoy a marked increase. Exports are often increased 10 or even a 100-fold. The production and livelihood needs of the local population, on the other hand, are imported in increasingly large quantities and prices are greatly reduced. In this way, the people's standard of living is universally improved. Through highways, economic development is promoted and the conditions are created for the development of rich mineral deposits, so that new villages and market towns and industrial and mining bases have appeared in many areas.

Since the liberation, our country paid special attention to the development of engineering technique in highway construction. By learning from the Soviet Union and with the assistance and guidance of Soviet experts, we have drawn up and revised highway engineering planning rules, and corresponding design and construction codes and work regulations. The engineering and technical levels attained have been greatly raised throughout the country under the unified direction of the Central Government. We have accumulated rich experiences in building roads on plateaus, in the selection of routes in mountain areas, and in construction techniques used in crossing ice-bound land, salt lands, forests and swamp land. The engineering quality of all construction work has

been considerably raised.

In order to meet the needs of construction work, various localities have established scientific highway research equipment. Since the big leap forward of 1958, we have also developed new creations in engineering work connected with arched bridges with spans of more than 50 meters. In addition, during the past 10 years we have also selflessly supported some fraternal countries and other countries in the construction of highways and bridges. Generally speaking, the achievements of highway construction in new China have been great and brilliant. It has played an important role in enlivening the urban-rural interflow of supplies, consolidation of the worker-peasant alliance, the unity of the people of all nationalities, consolidation of national defense, improvement of the people's living standards and support of socialist construction.

II

During the past 10 years, the highway construction enterprise in our country has taken large strides forward under the illumination of the general line for socialist construction laid down by the Party. This was accomplished by the exertion of the utmost effort by pressing forward consistently, and by achieving greater, faster, better and more economical results in the wake of the flying development of national socialist construction.

We have relied on the correct leadership of Party committees at all levels, allowed politics to assume command and mobilized the broad masses for active participation in our work. The task has been carried out with nationwide construction of highways as the primary goal, and this is combined with the policy of improving quality.

During the first stage of the liberation, we took over from old China highways which were damaged. We rapidly overhauled and improved them under the policy of maintaining all roads in a usable condition, and protecting all existing roads. In addition, some new trunk lines were constructed.

During the period of the First Five-Year Plan, the distribution of highway construction was carried out in a rational manner, in accordance with the development of the economy and the needs created by the military and political situations. In the national minority areas, national defense frontiers, and forests and mountain areas with mineral deposits we con-

structed large numbers of trunk highways of the Sixth Grade and above, and modern steel concrete bridges. In the course of surveying, designing, and construction, we greatly developed and raised the technical strength and technical level of our engineering forces. This played a guiding role in the highway construction undertaken by various provinces and regions in China.

We combined the advanced engineering and technical experiences of the Soviet Union and other fraternal countries with the practical conditions in our country, and extensively studied and utilized their experiences. At the same time we accumulated rich experiences in our own country in highway surveying, designing, construction and management. Thousands of civilian road builders with a knowledge of road construction are distributed throughout the cities and rural areas of the motherland.

In 1958, to meet the needs of national construction, we transferred the highway engineering, surveying, designing and construction forces which were directly subordinate to the Central Government down to the various provinces and regions. This gave effective support to the big leap forward in industrial and agricultural production in 1958, especially to the mass road building movement which came into being as the result of the urgent needs of the huge bumper harvest. The quality of road building organization has also improved year after year.

After the mass movement for road construction led to the building of a large number of highways, we took timely action in attending to the regular maintenance of roads. We held tightly to the work of consolidation and elevation, and up to the present, in all parts of the country, there are already more than 100,000 workers especially organized for the maintenance of highways. We have raised and improved the conditions of the highways through large, medium sized and small repairs carried out under our maintenance programs.

Furthermore, in undertaking socialist economic development in the mountainous areas of our country, special attention must be given to vigorous development of them. And the prerequisite to this is their accessibility by road. Accordingly, during the past 10 years, in addition to the construction of many highways, we have also constructed large numbers of other kinds of roads which are suited to the communications and transport needs of the mountain areas. Since the winter of

1958 alone, we have built 65,332 kilometers of village roads and cart tracks; 5,209 kilometers of wooden rail tracks; and 6,770 kilometers of roads with chain guard rails. All this has economized a large volume of manpower and effectively supported industrial and agricultural production. These roads on the one hand economically and practically have solved the current urgent needs of production and transport, and on the other hand have created conditions favorable to the future construction of modern highways or other communications facilities.

The construction and maintenance of roads serves transportation. In transportation we have adopted the policy of walking on two feet. Similarly, in road building we must also adopt the policy of walking on two feet. The experiences of the past 10 years prove that we have been entirely correct in adopting the measures of attending to both construction and maintenance, and of attending to both the trunk lines and the branch lines in our implementation of the above mentioned policy. These measures must be continued.

The Chinese people are industrious and courageous. Since ancient times, the construction of bridges and roads was considered an excellent virtue among the broad masses. During the early stage of socialist construction in our country our capital funds are limited, and at the moment they must first be spent in the areas most concerned with industrial and agricultural production and to meet the requirements of the people. We cannot afford huge investments in highway construction over our extensive territory of 9.6 million square kilometers. In accordance with the experiences of the Soviet Union in building socialism over the past few decades and with the conditions in our country, the state in 1950 and 1955 respectively issued and revised directives on "Construction Utilizing Civilian Labor". Various provinces and regions have also formulated concrete regulations and measures in accordance with these directives.

During these past years, we have relied on the spontaneous and voluntary enthusiasm of the masses in road construction. This construction has been based on the people's production needs, and has been done in accordance with the provisions concerning use of civilian labor. We have mobilized and organized large forces of manpower and material resources for the development of many mass movements for road construction, and utilized the off seasons in farming and proper planning and leadership.

In these road building movements, the masses made innumerable creations and inventions, and numberless epic exemplary incidents and heroic personalities emerged. Particularly worthy of mention are the force of the elite children of the Chinese nation - the Chinese People's Liberation Army - and the road building forces organized by the local masses which carried out their work on plateaus 4,000 meters above sea level where the atmosphere is thin, on the grass plains devoid of population, and in the desert, forest and bog areas ice-bound the year round. In mountain areas with precipices, rocks, and thick growths of wild vegetation, such workers struggled courageously in the building of roads and bridges with a selfless spirit to labor, braved storms and rains, resisted sandstorms, crossed high mountains and large rivers, overcame severe cold and scorching heat and supply difficulties, and worked without regard for their own lives. Such a traditionally excellent virtue is worthy of special development and promotion in the future.

The improvement of technical equipment and the technological renovation of highway capital construction must be based on the development of the national economy and the level of industrialization. Under the present circumstances in our country where the petroleum, rubber, steel and cement industries are not extensively developed these limited supplies must be used in the most needed places in our national construction. Accordingly, under existing conditions, we still face many difficulties in the construction of large numbers of high-grade highways.

In order to actively support our country's socialist construction, and to cope with the daily growing needs for passenger and freight traffic we must rely on the activism of the masses of various localities who urgently need the roads to procure materials locally, use their own effort to carry out rejuvenation, to muster the joint efforts of all the people, to build various types of roads to serve the needs of the various local transport equipment, to satisfy or improve the local communication needs, and to promote industrial and agricultural production. We may then gradually improve these roads through the strengthening of maintenance and protection measures, or through further construction in stages. Let us first determine the availability of transport facilities and then look after their quality by gradually reconstructing them with surfaces of a higher grade in accordance with the development of the volume of transport.

We have guided the selection of routes and decided on technical standards, grades and designs for all road structures in accordance with the spirit of the general principle of "suitability and economy, taking into consideration local requirements and appropriately taking care of future development." And correspondingly, we have formulated and revised unified highway engineering technical standards and various regulations and rules for the whole country.

On the basis of studying work in the Soviet Union and the accumulation of work experiences in various parts of our country, we have carried out the timely summarization of our work experiences in surveying, design work and construction. From this we have formulated various work systems and management measures. We have implemented socialist economic accounting, continually improved labor organization, renovated working tools, raised engineering and technical levels, lowered engineering costs, raised labor productivity and accelerated the speed of highway construction. During the past 10 years, we have used these technical and economic policies to guide all our highway work. Practical experience has proved that these measures have been entirely correct, and must continue to be thoroughly implemented in the future.

On the basis of our experiences over the past years we must, in addition to relying on the labor power of our 500 million peasants and utilizing the slack farming seasons for the development of the mass movement for construction and maintenance of roads, also construct highways over the newly reclaimed areas only sparsely populated and with a lack of communications facilities in order to accelerate highway construction. And in order to meet the needs of the growing freight volume which has to be carried by modern transport facilities, which calls for the construction of roads and bridges of higher grades and greater technical complications, we must also establish a specialized road building force ready for work at all times. At the same time we must constantly equip this force and raise its technical level to include mechanized operations.

We did that during the First Five-Year Plan, and through that we achieved better results. In 1958 the Central Government transferred surveying, design and construction forces directly under its control down to the provincial and regional level, and this has enabled the latter to acquire greater facilities for the establishment of more specialized road building forces. This will expand and foster our country's

surveying, design and construction technical forces, systematically accumulate work experiences in different operations, and promote the planned study and utilization of all kinds of advanced scientific and technical achievements. These then can be translated into model measures for guiding the different localities in the whole country in road construction. When there are emergency tasks, these forces can easily be concentrated and assigned to points where they are needed. Thus the establishment of regular specialized road building forces will bring many benefits and is also in conformity with objective needs.

At the present moment various areas in the whole country are promoting the mass movement for the building and maintenance of roads, and are selecting excellent individuals to be turned into specialized workers in accordance with particular needs. The people can also be fostered and steeled through actual work, and continual attention should be given to the raising of their political awakening and technical ability.

In the renovation of tools for road construction and maintenance in many provinces and regions the authorities have carried out the realization of semi-mechanized and mechanized operations through reliance on the masses, locally procured materials, and construction in accordance with needs and possibilities. They have thus economized on a large amount of labor power, and the technical aspects of the roads have been improved and elevated, while newly constructed and renovated roads have continually increased. The future history of highway construction will again prove the necessity for such measures for organized construction.

III

In a word, the people's highway construction enterprise of our country during the past 10 years has achieved brilliant and colossal results under the wise leadership of the Communist Party and Chairman Mao. In our work we have thoroughly implemented the Party's general line for socialist construction and various work policies and measures. We have acquired rich experiences and laid the foundation for building in the future more and better roads of various types for the country. However, our country is so vast, its area so extensive and its resources extremely rich, so that many areas are still only being initially developed or are still awaiting development. With the big leap forward in industrial and agricultural pro-

duction, the highway construction enterprise must be given more glorious and gigantic tasks. We must therefore further attend properly to our task as the "vanguard", and create more and greater brilliant achievements.

At the present moment when we are developing the mass movement for short distance transportation, the urgent tasks of highway workers doing road maintenance are as follows. We must take up simultaneously the various communications construction tasks which serve over short distances on the branch lines and over the trunk lines. Under the unified leadership of the various local Party committees, the people must actively support the communications construction of large, medium and small scale enterprises, factories and mines, assist in planning and technical guidance, and take the initiative in serving as vanguards in the development of short distance transportation. We must rapidly mobilize and organize forces and extensively develop and improve all the types of roads which are suited to traffic for various short distance transportation vehicles.

At the same time the people must take care of the maintenance and protection of trunk lines and branch lines, improve and raise their quality, ensure safety and smoothness of transportation and promote increased efficiency. They must earnestly implement the resolution on production increase and economy adopted by the Eighth Plenum of the Eighth Central Committee of the Party, develop socialist emulation centered around technical renovation and the technological revolution to guarantee the fulfillment and overfulfillment of the 1959 plans for road construction and road maintenance. This is the glorious task which we shoulder.

In the near future, the construction of people's highways and all types of roads suited to communications in our mountain areas will be distributed over all corners of our country, like the arteries of the human body. By that time, suitable roads will take us to all large, medium and small cities and towns, industrial and mining areas, forest areas, farming areas, all residential points, scenic spots, historical sites, resort areas and the frontier spots of importance in the motherland. The highways, together with the railways, shipping and aviation will constitute our country's modern communications and transportation network that will reach in all directions.

People who work tensely for the building of great socialism will, when riding on the highways covering the great expanse of the motherland - which will be adorned with trees and be as

beautiful as a garden - will surely feel mentally at peace, and spiritually uplifted, so that they will all the more want to develop their boundless wisdom and strength. At this juncture, as our country celebrates the Tenth Anniversary and all the people are joyously taking part in the festival, I respectfully pen this article in felicitation. I believe that our highway enterprise in the future will develop a greater role and shed more brilliant rays under the leadership of the great Chinese Communist Party in the course of building a beautiful and prosperous nation by all the people of the country.

TEN YEARS OF HIGHWAY SURVEYING AND DESIGN WORK

[This is a translation of an article written by I Pu (Deputy Chief, Designing Institute, Central Highway Bureau, Ministry of Communications) which appears in Kung-lu (Highway), no 10, 5 Sep 59, pp 11-13.]

"Without surveying there will be no designing, and without designing there will be no construction." Highway surveying and design work is an advanced undertaking in highway capital construction, and it serves as the vanguard for the national road construction army. During the past 10 years, under the leadership of the Party, surveying forces travelled all over the country, overcame difficulties which many people considered insurmountable and achieved brilliant results. They further expanded their strength and raised their technical levels in the wake of the flying development of socialist economic construction throughout the country.

"Let High Mountains Bow Low, and Rivers Give Way."

Highway surveying and design work must cope with the rapidly growing highway construction task. It must not only fully develop the greatest role of highways in the development of the national economy, but also overcome natural obstacles, guarantee technical quality and economize state investments and satisfy construction needs.

Under such premises, during the past 10 years, highway routes surveyed and designed in the whole country (including lines newly constructed and renovated) amounted to more than 300,000 kilometers. This is according to incomplete statistics.

Among the highways surveyed, there are the famous Sikkim-Tibet, Tsinghai-Tibet and Sinkiang-Tibet roads which cross the "Roof of the World"; highways which cut through primeval forest areas; as well as highways constructed in rocky loess areas with the most complex terrain, bog areas with special geological and hydrological characteristics, ice-bound areas, alkaline soaked desert areas, salt covered areas, areas with precipices, areas of alluvial sands, and areas of alluvial mud.

During the past 10 years, we also designed many special

bridges which cross various kinds of ravines and big rivers. According to incomplete statistics, up to 1958, throughout the whole country over 800 large bridges with a total length of more than 140,000 meters were surveyed and designed. Many of these bridges are on the frontier regions and reach over roaring currents never before crossed by man, and were built without hydrological data over rivers of great depth, swift currents, and wide water surfaces. These factors made surveying and design work most difficult.

Prominent examples of such bridges are those over the Nu Chiang, a noted natural danger spot, and the Ta-tu Ho and Chin-sha Chiang.

Some large bridges have been constructed over large rivers along the coast severely affected by tides. And, some are in interior areas where the earthquake potential is graded as high. In addition, the beds of rivers in some cases are geologically very complicated, with the river courses changing year after year.

The special characteristics of these natural conditions have increased the complexity of technique. Under the above conditions, surveying and design personnel must fight with nature and overcome numerous technical difficulties both in surveying and in designing economic and rational routes and bridge sites and types if they are to achieve quality, speed, quantity and economy in highway construction.

Growth and Gain in Strength

Surveying and design work on highways as an independent enterprise and its flying development only started after liberation under the leadership of the Chinese Communist Party.

Before liberation, highways were constructed only to serve as tools of the imperialists for aggression, and to serve the reactionary ruling classes for the oppression and exploitation of the people and the suppression of the revolutionary forces. Surveying and design work had never been given important attention, and there was no specialized machinery or specialized forces, while technique was poor and backward.

During the early stage of liberation, highway construction was mainly concerned with the restoration and improvement of original highways, but at the same time a small number of more

important new lines were also built.

During the period of the First Five-Year Plan, in accordance with the needs of the development of the national economy, the communications departments of the various administrative regions in 1953 established highway planning companies to enable highway surveying and designing to march a step ahead in highway construction in order to ensure engineering quality and to accelerate the speed of construction.

In 1954 the General Highway Bureau officially inaugurated the Highway Planning Bureau, and changed the various planning companies into its branch bureaus. Under the unified leadership of the Planning Bureau, the Bureau concentrated a force of more than 1,200 specialized technical personnel and technical workers for the formation of a regular surveying corps, a bridge surveying corps and a drilling and prospecting corps. It thereby laid the organic foundation for the fostering, improvement and expansion of the surveying and designing forces. They did not include the various local provincial surveying corps.

During this period, the Party brought forward the call for "the resolute study of Soviet advanced experiences", and at the same time paid special attention to the ideological remolding of engineering and technical personnel. Since 1950, under the selfless and concrete assistance given by the Soviet experts, we systematically studied whole sets of the advanced Soviet experiences and through that highway surveying and design work was freed from the state of decadence and crudeness which existed before liberation.

Through the great rectification campaign, we criticized bourgeois surveying and design thinking, established socialist surveying and design thinking, broke down the conservative and suspicious attitude toward advanced techniques, and penetratingly studied and mastered, with full confidence, new techniques. To seek an economic and rational route or bridge site, our workers would bring forward the action slogan of "walk more, see more and compare more." They carried out analysis and study of routes and bridge sites previously chosen in a matter-of-fact manner. They raised the quality of design, economized on investments in construction, and at the same time greatly enriched and elevated the personal experiences and technical levels of the technical personnel themselves.

In 1956, the Highway Designing Bureau was changed into the

Designing Institute and the branch bureaus into branch institutes. The surveying and designing forces of the Highway Surveying and Designing Institute, which are directly under the Ministry of Communications, have been developed into 45 surveying corps, six large bridge surveying corps and 30 drilling and prospecting corps with a total of more than 2,700 technical personnel and technical workers. Under the general policy of overall designing and strengthened leadership, the various provinces in the country have also established everywhere local surveying and designing forces from scratch, and they have developed from a small beginning into an army of from 5,000 to 6,000 specialized personnel.

In 1958, the Party's general line for "the exertion of the utmost effort and to press forward consistently and build socialism with greater, faster, better and more economical results", stimulated all production and construction departments throughout the country. With the promulgation of the revised draft of the Agricultural Development Program and the victory of the all-people's rectification campaign, a high tide of production and construction appeared throughout the country. Under the communications policy of "relying on local areas, relying on the masses, and combining universalization with improvement, with universalization as the major goal." [sic] the Highway Designing Institute transferred to the provinces all the five branch institutes and all their productive corps. This was done in order to effectively coordinate its work with the mass movement for road construction launched vigorously in the winter of 1958 and the spring of 1959.

When these cadres were transferred to the provinces, they carried out in coordination with the original local surveying squads shock efforts in surveying and designing provincial trunk lines. They also fostered and expanded large surveying and designing forces at the administrative district and hsien levels. They thus developed a great situation in the overall development of highway surveying and designing throughout the whole country.

The Designing Institute itself also thoroughly implemented the policy of communications construction through "local efforts, efforts of the masses, and universalization of efforts." It brought forward the action slogan of "sending technique to the doors of the people, and carrying out designing at the work sites", and organized in a timely manner meetings for the interchange of advanced experiences, on-the-spot conferences, and the utilization of written messages and broadcasts for the

popularization of highway surveying and designing techniques.

The Institute also operated new techniques training courses, and organized separately the collective designing of especially large bridges in different localities, so that the highway surveying and designing forces would be further popularized and strengthened on a nation-wide basis. Simultaneously, we have gradually established from scratch a comparatively complete set of regulations and systems governing the organization and management of highway surveying and designing work.

Elevation of Technical Levels

In the construction of highways in old China, in connection with the routes developed, attention was generally paid simply to gradients, curves and width, and there was the one-sided desire to minimize earth and stone work. The designing of large bridges and culverts was generally lacking in scientific basis, and subjective conjecture was relied upon. In the designing of large bridges, no attempt was made to master the scientific knowledge in the computation of hydrological and hydraulic figures, the length of a bridge being generally determined by the width of the river. In structural theory, backward and outdated rules and conventions were followed and great waste resulted. The sinking of road beds, the washing away of road surfaces and the washing away of bridges and culverts were frequent occurrences.

After liberation, following the study and mastering of advanced techniques, the decision on routes is being undertaken with full recognition of the important bearing on route design exerted by hydrological and geological conditions. These are fully considered. At the same time, in the course of the flying development of our economic construction new factories, mines, forest areas, railways, canals, conservation projects and new residential zones are continually emerging, and we must take steps to coordinate with the resulting changes in the appearance of nature in order to avoid mutual conflict.

During the period of the reactionary Kuomintang rule, many areas in our country lacked detailed and dependable maps, and there were few detailed hydrological, weather and geological records. For this reason we do face difficulties in our overall consideration of the rational provision of routes. Accordingly, in highway surveying work we attach special atten-

tion to inspection work prior to surveying. We have to fully understand and utilize favorable terrain to create conditions for the correct determination of routes, the establishment of intermediary control points, the comparison of bridge sites, the comparison of alternate routes, and consideration of the suitable grading of individual lines.

In the course of surveying highway routes, we use as our basis the preliminary results of inspection work and seek an overall consideration for the rational coordination of the altitude, length and breadth of a line in combination with local concrete geological and hydrological conditions. And, there is coordination between the route and the bridges, and the rational arrangements to be made for drainage systems. We thus strengthen the total concept of surveying and designing and thereby greatly raise the designing quality.

To enable road bed and road surface designing to be more scientific and rational, we have also paid special attention to drilling and prospecting work, experiments with building materials and the investigation of production centers for such materials. Thus in our designing we are able to take into account geological structure, the nature of the soil, and conditions relating to subterranean water in the determination of the depth of the road bed to be dug and the rational decision on gradients. We also thus have a reliable scientific basis for the designing of the road surface. At the same time we are also providing the necessary data for the designing of foundations of bridges and culverts and other artificial structures.

In the designing of bridges, we pay primary attention to the designing of bridge sites. With the vigorous development of weather and astronomical study activities in our country, and improvement of our theoretical designing of bridge sites, we are now able to decide on the most rational sizes and lengths, types or basic forms of bridges in accordance with hydrological investigations and existing hydrological data, and to make calculations in accordance with the actual or natural flow volume and erosion. Through these methods, we have greatly reduced the lengths of bridges on the basis of reliable scientific data, and provided a guarantee as to their safety.

Secondly, with reference to structural forms, we have also gradually adopted more and more prefabricated bridges and constructed at key points suspension bridges. We have also designed some bridges with large spans. Examples are: 60-meter

stone arched bridges; 50-meter steel concrete prefabricated top-arched bridges; 50-meter steel concrete prefabricated girder bridges; and thin layer connected truss or cantilever bridges.

In designing theory, we have worked on the problem of distribution of load over the surface of a bridge, and have replaced the method of calculating the number of beams with the method of compression at central points. At present we are studying the application of the theory of limitations so that designing may become even more practical, more scientific and more rational.

Furthermore, in the field of geological prospecting, we have started on a nation-wide basis the study of electrical prospecting and thus laid the preliminary foundation for the acceleration of prospecting speed, the improvement of designing quality, the reduction of prospecting costs and further improvement of our technical level in this field.

Fountain of Success

During the past 10 years, we have made colossal achievements in the development, elevation and expansion of highway surveying and designing work. The real source of these achievements is the correct leadership of the Party and the selfless assistance of the great Soviet Union. Three prominent characteristics promoted the transformation of the former state of decay into a great blossoming garden. They are: (1) Undivided attention to socialist ideological education work; (2) Earnest implementation of the Party's policies and measures and vigorous study of the advanced experiences of the Soviet Union; and (3) Implementation of the work method of the mass line.

Highway surveying and designing work in itself possesses the characteristics of dispersal and mobility. In addition to the provision of full time political workers in the surveying corps charged with the responsibility of political education, ideological education and the periodical convocation of extra-curricular production conferences, each year we have also devoted special time for concentrated political studies and professional studies.

The successive social and political movements, and the construction policies pointed out by the Party during each period, particularly policies connected with highway construction, have all proved of great help to raising the ideological

level and policy level of the surveying and designing personnel. After the Party advocated the democratization of technique and the communications construction policy of devoting "local, mass and universal efforts", highway surveying and designing activities made an unprecedented flying development. This proves that only by strengthening the leadership of the Party, having politics assume command, and fully relying on the masses may our enterprise continually leap forward with greater, faster, better and more economical achievements.

Continued Leap Forward

A period of 10 years is only a short history for the people's highway surveying and design enterprise in which to develop. At the moment, all provinces universally possess specialized forces for highway surveying and design work, and they are developing the role of vanguards in the opening up of mountain areas and crossing bodies of water. However, because our country is so extensive and the natural conditions in different areas are so dissimilar our current primary task is for different areas to take into account their own regional characteristics in the promotion of their work.

In addition, they must further raise the levels of organization, management and technique. They must establish more practical and more all-embracing new regulations and systems in accordance with the situation of the continued leap forward of the national economy. They must continue to exert the fullest efforts, and press forward consistently on the technological revolutionary front so that highway surveying and designing work may increase labor productivity and surveying and construction quality, and economize more on materials and capital funds.

We have the greatest confidence that we can, under the leadership of the Party, continue to implement the communications construction policy of exerting "local, mass and universal efforts". In the wake of the continuous leap forward of the great socialist construction cause, the people's highway surveying and designing work will achieve more brilliant new victories.

DECADE OF ACHIEVEMENTS IN HIGHWAY OPERATIONS

[This is a translation of an article written by Li T'ien-chu (Chief, Planning Department, Central Highway Bureau, Ministry of Communications), which appears in Kung-Lu (Highway), no 11, 20 Sep 59, pp 18-20.]

I

As the people throughout the whole country are joyously and enthusiastically celebrating the tenth anniversary of the founding of the state and reviewing the vigorous development in all fields of socialist construction, we have also made brilliant achievements of an unprecedented nature in the highway enterprise.

The construction of bridges and repairing of roads has an excellent tradition among our people. As early as about 2,500 B.C., our ancestors had appointed a "ssu kung kuan" [minister] in charge of roads. During the Ts'in Dynasty, there was not only the saying that "there is one common language for our books" and "the same type of wheels for our vehicles", but the people already started to seek beauty of line in their carriages. Chu-ko Liang (cir. 230 A.D.), manufactured the "wooden cattle and horses", and this has been handed down to us as a popular legend. Li Chun (cir. 605 A.D.) constructed a marble bridge with a span of 37 meters, and it still stands to the south of the city of Chao Hsien in Hopei. These crystallizations of the diligent labor of the working people of successive dynasties clearly show the unbounded creativeness and wisdom of our people.

Modern motor transportation in China started with the incursion of imperialism into our country. From its birth to its growth to maturity, however, the highway enterprise of old China had consistently been used as a tool for the reactionary ruling classes. Just as was the case with the general economic depression under the Kuomintang rule, during the 37 years from 1913 through 1949, the whole country built only 130,000 kilometers of highways. Later they were subjected to repeated damage, so that by the time of liberation, only 75,000 kilometers were open to motor traffic in all of the country. In the whole country, 52 percent of hsien cities were not accessible to motor vehicles. This was extremely incompatible with the

large expanse of territory of our country and its huge population.

The aim of the reactionary government in the building of these highways was to plunder the people's wealth and to suppress the people's revolution, and to facilitate attacks on the revolutionary bases. Thus the distribution of these highways was more irrational. In the extensive regions of the southwest and the northwest, and in the mountain areas and plateaus where highways are specially needed, no roads were available. The quality of the highways was also extremely inferior. From the beginning, highway construction was undertaken in a haphazard manner and work was carried out indiscriminately. All that was sought was mere access to a given point, so that the routes were bad, the grades steep and the turnings abrupt. There was inadequate surfacing, bridges were lacking and ferry facilities were scanty. The motor vehicles, parts, -- tires and gasoline were all supplied by foreign countries.

Though the motor transport industry was started by private enterprises, it was very weak. During the period of the war of resistance against Japan, the Kuomintang retreated to the southwest and the northwest, and experienced difficulties in communications. The Kuomintang authorities obtained from the American imperialists a fleet of motor vehicles and they immediately utilized their reactionary regime to monopolize the highway transport trunk lines and to manipulate freight rates and the transport market. The motor transport industry was thus used as a means for the extortion of the people, so that they could wax rich during the war.

After victory in the war against Japan, the reactionary ruling classes used what little motor transport forces they had in the war they conducted to massacre the people. And when the people's liberation struggle in our country was achieving nationwide victory, the highway transport industry was further subjected to very serious damage in the hands of the Kuomintang reactionaries. Bridges were burned and destroyed, road foundations were dug up in a manner described by the saying, "Cutting up the tender intestines into inch lengths", and large numbers of vehicles were destroyed or dumped into ravines. At the time, we took over 229 motor vehicles in Tientsin, and only 42 of them were in running order. In Peiping we took over 250 vehicles, and only 39 could take to the road. Repair facilities were especially destroyed, and the damage was widespread. The highway transport industry in the country as a whole was then

in a state of paralysis.

II

On October 1, 1949, the great People's Republic of China was born. Since then, in accordance with the general policy brought forward by the Party for the overall restoration of the national economy, highway transportation was given attention. In the construction and maintenance of highways, we carried out an overall restoration of traffic facilities through repair and improvement of key routes, and started the construction of new highways in the frontier regions. In the promotion of transportation, we actively organized and restored to a good state of repair the old vehicles and workshops, and organized the people's transport forces and private motor transport enterprises with the state operated transport enterprises as the backbone and leading force. This was done to raise the transport capacity and promote urban-rural intercourse in the service of production and construction.

After three years of restoration and overhaul activities, the total increased highway mileage in China amounted to more than 50,000 kilometers; and by the end of 1952, we already had more than 120,000 kilometers of highways open to traffic. A portion of the increased distance was achieved in the areas of our fraternal nationalities in the northwest and the southwest, by which we began to change the former state of imbalance which existed in our original network of highways. We also consolidated the highways which the masses of the people spontaneously preserved through emergency efforts during the war of liberation, and carried out technological improvements on over 20,000 kilometers of highways. And we paved road surfaces and renovated or completely rebuilt bridges. In addition, the state operated transportation enterprises repairing over 5,000 old vehicles within a short period.

After the American imperialists launched the war of aggression in Korea, they enforced the policy of sanctions against our country in an attempt to throttle our economic construction. But under the leadership of the Party and with the support of the people of the whole country, highway workers developed the excellent tradition of the working class, actively adopted measures for rejuvenation through self-effort, adjusted schedules, repaired vehicles, undertook by themselves the manufacture of accessories, and overcame all kinds of difficulties enabling the highway transport industry to enjoy a great develop-

ment.

In 1952, state operated transport enterprises throughout the country increased stations and stopping points by 105.8 percent over 1950; and the routes operated showed an increase of 51 percent over 1950, or an increase of 305 percent over the days of the Kuomintang rule. Highway transport stations were gradually extended to the rural areas, operational routes were expanded and the number of motor vehicles were increased. The volume of traffic of state operated motor vehicles alone in 1951 showed an increase of 64.2 percent over 1950, and in 1952, it showed a further increase of 106.5 percent over 1951. This exceeded the highest figures recorded in the history of the Kuomintang rule. We basically turned about the state of depression and paralysis which existed at the time of the taking over. We achieved marked results and laid the foundation for further construction on a large scale.

Since 1953, our country has embarked on large scale economic construction. In face of the rapid strides made in our national economy, we have also achieved great victory in highway construction. During the period of the First Five-Year Plan, the whole country constructed more than 150,000 kilometers of highways, being 17.4 percent in excess of the total distance of highways constructed by the Kuomintang during all its rule. By the end of 1957, highways in the whole country exceeded 250,000 kilometers in length, being 340 percent of that at the time of liberation.

The construction of these highways is changing the state of imbalance in the distribution of highways in our country. In the southwest and the northwest, where there formerly was few highways, development has been more rapid. In the mountain areas the highways have also shown a marked increase. In the coastal areas on the east and in the central basin of the country, we have also built many trunk and branch lines in accordance with the growth of transport needs.

At the same time, the quality of the highways has been rapidly improved. During the period of the First Five-Year Plan, more than 48,000 kilometers of highway were rebuilt through capital construction efforts; 40,000 kilometers of highway over which traffic is heavy were raised to a higher level of efficiency through maintenance efforts; about 20,000 kilometers of mud roads were improved; a total length of 240,000 meters of bridges was constructed; and 36,000 kilometers of highways were paved with gravel. The speed of travel was

greatly accelerated as a result of these improvements.

During the second half of 1955, the socialist hightide came to our rural areas, and the demand for large scale production increases arose. In the two years of 1956 and 1957, peasants throughout the country enthusiastically threw themselves into highway construction, and they built 100,000 kilometers of roads. By the end of 1957, 1916 of the 2067 hsien cities scattered throughout the whole country, with the exception of Taiwan and Tibet, were made accessible by highway (of the remaining 151 hsien cities, 22 are linked by railway or seaports). The majority of the more important hsiang and chen are also accessible by highway. At the same time we also built large numbers of roads which can be used for various types of public traffic conveyances.

We have also made great achievements in highway transportation. The targets laid down in the First Five-Year Plan for passenger traffic volume and freight volume were fulfilled ahead of schedule by one year and a half and one year respectively. The freight traffic volume in 1957 showed an increase of 280 percent over 1952, and the passenger traffic volume showed an increase of 410 percent. The number of vehicles owned by the highway transport system showed an increase of 60 percent over 1952, and this was in excess of the highest number possessed during the entire history of the Kuomintang rule.

Highway stations and stopping points existing in 1957 represented an increase of 146.5 percent over 1952. And mileage covered by scheduled services showed an increase of 147.2 percent over 1952, and they are being extended greatly to the frontier regions, areas inhabited by our fraternal nationalities and the old liberated areas.

According to statistical data for 1957, of the total volume of goods carried 38.6 percent consisted of capital construction materials; 17.1 percent of agricultural, native and special products; and 21.6 percent of industrial products. These major items together made up 77.3 percent of the freight carried. This movingly tells us how the highway transport industry is contributing to economic construction and the improvement of the people's livelihood in the midst of the large scale economic construction of our country. Simultaneous with the development of highway motor transport, we have effectively utilized the people's transport tools, and organized and developed their role in regional short distance transport.

In 1955 and during the early part of 1956, in the wake of the high tide of agricultural cooperation and the high tide of the socialist transformation of capitalist industry and commerce, capitalist transport enterprises also carried out the conversion into joint public-private operation by whole trades. On the basis of their personal experiences, individual transport operators recognized the superiority of the road to cooperation, and they smoothly took to the great road of socialism. Thus, the Socialist economy achieved a complete and decisive victory in the highway transport departments.

In 1958, after the highway enterprises throughout the country over-fulfilled the First Five-Year Plan, the Second Five-Year Plan was victoriously launched. As the result of the victory in the rectification campaign and the anti-rightist movement, a new situation of a big leap forward descended on production and construction in the whole country. Communications and transport enterprises also brought into being the high tide of a vigorous mass movement and of production and construction under the illumination of the general line for the "exertion of the utmost effort, pressing forward consistently, and building socialism with greater, faster, better and more economical achievements".

During the first half of 1958, there was a big leap forward in agricultural production. The extensive rural areas were developing water conservancy projects to vigorously increase production, and they deeply felt a lack of roads and the insufficiency of transport forces. In order to resolve this contradiction, under the leadership of the Party committees and governments of various localities, the broad masses of the people vigorously launched the mass movement for the building of roads. Many areas were converted from road-less areas into areas served by roads. The construction of roads, the building of bridges and the production of vehicles became the objects of a vigorous mass movement.

In the second half of 1958, in the wake of the mass movement for the vigorous development of iron and steel, highway transport became all the more vigorously and energetically developed. This large transport army, with motor vehicles as the backbone, consisted of tractors, horse drawn wagons, mule carts, pushcarts, bicycles and all kinds and all forms of vehicles. It was a grand land force which operated day and night, braving windstorms and rainfall, and shouldering a tense and heavy task. To cope with the great volume of iron and steel transportation needs, we also built many highways. Some on a

large scale and some on a smaller scale. The backward condition of highway transportation in our country, which we inherited from the past, was undergoing a profound change.

During the single year of 1958, the whole country built 150,000 kilometers of new highways (including simple highways). This was more than twice the increase in distance achieved during the whole period of the First Five-Year Plan, and exceeded the sum total of roads built during the thirty years prior to liberation. The total length of highways in the whole country now exceeds 400,000 kilometers. The transport system owns motor vehicles amounting to 217 percent of the number existing during the early period of liberation.

The highway transport departments have enforced the system of the use of trailers for transport. During 1958, we manufactured more than 30,000 trailers with a load capacity of more than 90,000 tons. The adoption of the trailer system has made it possible to fully develop the capacity of the motor equipment of the vehicles, and to fully develop the inherent engine capacity of the motor vehicles. At the same time, manufacturing a trailer is easier than manufacturing a motor vehicle. This is an important measure for the solution of the current tense situation arising out of a lack of vehicles to cope with the large volume of freight. It is also a move toward unearthing the transport potentials of motor vehicles and a way to increase transport capacity for a considerably long period to come. In 1958, as the result of the use of trailers in combination with other innovations, the annual freight volume for each vehicle reached over 150,000 ton-kilometers, which was 360 percent of that of 1952. That is to say, a motor vehicle in 1958 did the work of what three to four vehicles did in 1952.

In 1958 we also fully developed the potential of the transport tools of the people. Transport vehicles underwent technological renovation, and ballbearings were installed. Two-wheel rubber trucks were converted into four-wheel rubber trucks. Man-drawn carts were converted into animal-drawn carts. Some vehicles had adjustable bodies installed, and their load capacities were greatly increased and transport efficiency raised.

In the repair and maintenance of roads, the masses were relied upon greatly. Materials were procured locally, and many road construction and maintenance supplies, such as dynamite, lime and cement were locally manufactured. We also launched the movement for mechanization and semi-mechanization, and manu-

factured many kinds and types of stone crushing machines, supply carrying vehicles, sand sweeping machines, water spraying carts, road paving machines, mixers and rollers.

III

The development of the people's highway enterprise during the past decade represented a very short period. But in this short period, we have made flying development in our highway enterprise. During the early stage of the founding of the nation, the highways played a prominent role in the annihilation of remnant bandit groups, the promotion of social reforms, and the consolidation of frontier and coastal defense. During the period of the large scale economic construction in our country, the highways likewise played a very important role both in the newly developed areas and in the national minority areas, both in lending support to agricultural production and in the fulfillment of the emergency tasks during various periods.

For example, in the development of the Tsiadam Basin, highway construction was started in 1954. Today, in the basin highway transport occupies a place of absolute importance. The highways from Tun-huang to Mang-yai, from Tun-huang to Ka-erh-mu, the Tsinghai-Tibet Highway, the Tsinghai-Sinkiang Highway, and the highway from Ch'a-ch'ia to Mang-yai have linked together the communication centers of Ka-erh-mu, Ch'a-ch'ia, Ta-ch'ai-tai and Mang-yai. In 1953, Ka-erh-mu was still a desolate and uninhabited primeval wasteland, and the road building army at the time had to pitch tents. In less than five years after the completion of the highway, it is now a town with many buildings and a population of more than 30,000.

With the construction of highways in our agricultural areas, the circulation of commodities has been facilitated, prices have been lowered and living standards have been raised. This has greatly stimulated the productive activism of the broad masses of peasants. For example, Hsi-hsia Hsien in Shantung was devoid of communication facilities in the past, and the people there had to use sweet potatoes for fuel and the peanut which they raised could not be shipped to other areas. And, they were not self-sufficient in grain. After highways were built, native and special products enjoyed a good sale, and this greatly roused the self-confidence of the local populace in production, so that they increased the areas devoted to peanut cultivation from 100,000 mou to 400,000 mou. After the production increase, the people not only became self-

sufficient in grain, but even had surplus grain for export.

With the highways open to traffic, the rural areas also saw a marked change in the long term situation in which heavy physical labor was involved since people carried loads on their backs. In Hunan Province, for instance, after the opening of the highway from Chi-shou to Feng-huang, the people changed the system of using man power to carry loads of commodities for export. During the year 1956, more than 10,000 tons of grain and native and special products were exported by motor vehicles, and more than 3,000 tons of supplies and consumer goods were imported. Through calculations, it was found that in transporting exports alone more than 400,000 man-days of manpower were saved, which effectively supported agricultural production.

In order to pave the way for the development of the frontier regions of our fraternal nationalities and the potential of the mountain areas, the Central Government paid special attention to the building of roads in these areas during the First Five-Year Plan. Investments in these roads took up 66 percent of the total and the mileage constructed constituted 61 percent of the total.

In order to forge links with Tibet we built three highways, the Sikang-Tibet Highway, the Tsinghai-Tibet Highway and the Sinkiang-Tibet Highway. These are on the Sikang-Tibetan Plateau, which is known the world over as the "Roof of the World". We overcame such difficulties as cliffs, steep gradients, landslides, bogs, primeval forests, glaciers, ice-slides and "floating" sand. With the completion in 1958 of the highway from Hsi-chang to Yen-yuan, which is more than 200 kilometers long, the fraternal nationalities of Yi, Manchu, Mongol and Lisu who inhabit the lower reaches of the Ya-lung Chiang established contacts with the outside world, and they no longer find it a hardship to live amidst the tall mountains and to travel the long valleys. The rich resources of these areas will also be developed.

During the past decade, natural calamities have occurred at different times in parts of our country. Because highway motor transport is efficient and flexible, transport departments in different localities actively participated in major shock [emergency] tasks in accordance with the local needs of the people as directed by the Party. In 1954 in Nanking, for instance, highway transport forces were used for the concentrated emergency efforts carried out to salvage supplies during the flood season. In Wuhan Municipality in July 1954, the

water levels of the Yangtze rose to its highest point in history and the authorities mobilized more than 1,000 vehicles and more than 2,700 transport personnel to participate in the emergency measures for the salvage of supplies. Highway transport has also played a very important role in municipal construction, inter-provincial support measures, large scale commodity shipments, and in fire prevention in the fire areas.

IV

During the short period of 10 years, highway enterprises have undergone a gliding development. This great transformation has been the result of the illumination afforded by the general line of the Party, the active support of the broad masses of working people, the enthusiastic participation of the various fraternal nationalities, and the unanimous efforts exerted by the whole body of highway workers under the leadership of the Party and government organs on all levels.

In the construction of the Tsinghai-Tibet and Sikang-Tibet highways, Chairman Mao, our great leader, personally wrote the message, "To Assist the Various Fraternal Nationalities We Must Not Fear Difficulties, and We Must Strenuously Construct Highways," which was addressed to all the road construction workers. This greatly encouraged and honored the workers. We are sincerely grateful for the deep concern shown by our great Party and our wise leader Chairman Mao.

During the past 10 years of highway construction our fraternal nation, the Soviet Union, sent excellent experts to our country to give us selfless help. In the brilliant achievements described above, we may also find the boundless friendship and fruits of labor of experts of various socialist fraternal countries.

We must not be satisfied with the achievements already won. We must resolutely implement the resolution of the Eighth Plenum of the Eighth Central Committee of the Party, overcome rightist thinking and continue to exert our utmost efforts. In the new upsurge in the production increase and economy movement brought into being by the highways and communications departments, we must use greater efforts to strive for the basic transformation of the highway transport situation in our country, and strive to approach or fulfill within 1959 the highway transport target set for realization in 1962 in the Second Five-Year Plan. We must also strive to realize, greatly ahead

of schedule, the task in communications construction set forth in Article 34 of the Twelve-Year Agricultural Development Program.

The motor vehicle industry is just being established and is being gradually developed. We shall gradually build up a transportation network which stretches out in all directions with modern transport equipment as the mainstay. We believe that with the leadership of the Party, the support of the broad masses and the effort of all of our comrade workers, we shall certainly make greater achievements in the years to come.

A DECADE OF DEVELOPMENT IN HIGHWAY TECHNIQUE AND SCIENCE

[This is a translation of an article written by Ma Pen (Chief, Highway Science Research Institute, Ministry of Communications), which appears in Kung-lu (Highway), no 11, 20 Sep 59, pp 21-23.]

The Chinese People's Republic has been in existence for 10 years. During the decade, under the wise leadership of the Chinese Communist Party and with the intense struggle put up by the people of the entire country, new China has been rapidly changing its historically extremely backward appearance, and has registered brilliant achievements unparalleled in history. Especially since the big leap forward of 1958, it has been marching forward in a flying manner at the rate of 1,000 li a day. With the rapid development of highway communication enterprises, the technical science of highways has also developed rapidly and achieved prominent results. They are briefly described here.

Continual Elevation of Highway Engineering Technical Standards

In old China, highway engineering technical standards and their relevant regulations were not unified, and they were dilapidated and incomplete. This was because old China was a semi-feudal and semi-colonial country. Its industry was extremely backward, and all engineering supplies, such as steel products, cement and even timber, had to be imported from capitalist countries. For this reason its technical standards and various regulations had to be copied from different capitalist countries. Naturally these did not conform with the actual conditions existing in China.

After liberation, China became unified as never before. National industry began to develop at a flying speed. This created the necessary conditions for the unification of standards, and the formulation of various regulations suited to the practical conditions of the country. In 1951 we initially formulated the national unified highway engineering designing regulations. They have since been revised twice, in 1954 and 1956 respectively, in accordance with the development of the situation and the continual elevation of our technical levels.

Because of the practice in 1958 of the innovation of attaching trailers to automobiles and the development of the use of trains of vehicles for transportation, and because of new results in scientific research, we are again revising the highway engineering regulations. During the decade, we have formulated 16 kinds of major technical regulations, and compiled 114 volumes of fixed plans. All of this has produced prominent effects on the raising of engineering quality, the acceleration of construction speed and the guarantee of safety in production.

Accelerated Surveying, Fixed Designing

Construction can only be taken up after surveying and designing is done. This is the basic procedure in highway construction. The goal of surveying and designing is to find a route which meets our needs and is also the most economical and the most rational. Before liberation, in the surveying of a route attention was only paid to the radius of curves, to gradients and to the width of road beds, but little attention was given to road beds, road surfaces, bridges and tunnels and other data which must be collected. As to hydrological, geological and other economic investigations, they were basically neglected, and experience or visual surveying was relied upon. Naturally this was without scientific basis.

After liberation, the Party gave primary attention to this question. We universally established specialized surveying and design systems in the central government and the local governments, fostered a large number of cadres and expanded our survey and design force. In the technical field of surveying and designing, we first established the three-stage and two-stage surveying and designing programs in whole sets, standardized the contents of designing documents, unified field surveying and designing methods, and established systems for the inspection and acceptance of designs. We also attached importance to hydrological and geological work, and especially emphasized experiences in investigation work and inspection work.

In order to cope with the big leap forward in highway construction, designing work was vigorously reformed. We initiated design types, the use of charts and maps for computations, the rapid designing method utilizing the multi-purpose single designing board and the flexible use of designing boards, so that the speed of designing was further increased.

Various Methods Used to Stabilize the Soil of Roadbeds

The quality of the roadbed directly affects the life of the surface, its quality and the investment required. Before liberation, the quality of the roadbed did not receive attention, and the technical requirements that should be met in building were not considered to be high. In the earthwork operations carried out manpower was not used to compress the soil, since the natural sinking of the roadbed was relied upon to achieve stability. After liberation, we adopted the use of manpower to compress roadbeds and the continuous working method to achieve the overall completion of work both on the roadbed and the surface. This accelerated construction speed, and enabled the highway to be opened to use earlier, and was thus of great significance.

The roadbed must be sufficiently strengthened and stabilized if the stability of the surface is to be guaranteed to a reasonable degree. The investigations we carried out in certain areas proved that when the roadbed compression coefficient is above 0.9, with each increase of compression rate by one percent, the extent of the change in the shape of the earth base under normal temperature is increased by 6 kilogram-square centimeters. If the value of K drops to 0.8, then the degree of change of the shape of the earth base varies by as much as 100 percent. This shows that the strength of the road base produces a decisive influence over the thickness of the surface. Accordingly the strengthening of the stability and strength of the roadbase is a direction in which our studies are bent.

The depth of the earth-fill over the roadbase is also closely connected with the stability and with the cost of the engineering work. In the northern part of our country, the depth of earth-fill over the road base directly affects the degree of water seepage. In the south the depth of earth-fill may be greatly reduced. In specially damp areas and where the terrain or engineering economy places limitations, we have also achieved satisfactory results in raising the stability of roadbeds through such measures as providing water interception ditches, sand bars, insulation layers, water detention or water infiltration bunds [dikes], and using different kinds of earth.

In the extensive areas in the north of our country, due to atmospheric conditions, the originally large water content of the earth base, and the growth of the traffic volume and increased use of heavy vehicles, each year during the spring thaw the phenomenon of water flowing out of the ground appears fre-

quently. This seriously affects transportation. After studies conducted during recent years, we have adopted such measures as the digging of open ditches along road sides, the digging of water storage areas, the digging of sand wells and laying of sand layers, the installation of insulation layers or heat insulation layers, the erection of sand bars and the construction of blind channels [channels without outlets].

Procure Materials Locally to Raise Quality of Road Surface

The construction of road surfaces takes up from 30 to 60 percent of the total construction cost of a highway. For this reason, the correct designing of the depth of the road surface is of great economic significance. Before liberation, surface designing was generally decided by experience, and there was no scientific study with the result that there were frequent cases of excessive depth or excessive shallowness. This affects the quality of the road surface and entailed a waste of capital funds.

After liberation, we adopted the advanced Soviet theories on surface structure and Soviet designing methods. In order that these better suited our own concrete conditions, we carried out a large scale comprehensive investigation of the types of earth bases on a nation wide basis. After carrying on efforts over the past two or three years, we have initially produced regional atmospheric maps of the country and also arrived at a coefficient for the measurement of the change of the basic forms of the soil. This is of great significance to highway designing in China. We must continue these efforts so as to gradually perfect our achievements and raise them to higher accuracy.

During the past few years, simultaneous with the nationwide investigation of road bases, we discovered in certain non-icebound areas and dry areas different types of thin layer road surfaces, about five to ten millimeters deep, which can be used. These roads carry a traffic far in excess of that arrived at utilizing existing design methods and coefficients. This has caught our attention and we are paying great attention to their study in order to unravel the law which describes the reason for this.

Of the transitional types of road surfaces in our country, the surface with mud mixed with pebbles and the surface of varying grades [of stones] are two structural forms which are representative. The road surface consisting of a mixture of

of mud and pebbles has a history of 40 years in our country. When its quality is guaranteed and maintenance of it is strengthened, it can easily endure a daily traffic volume of 500 vehicles under conditions of rain or shine. In areas with rich stone supplies and with a lack of heavy rolling machinery, this must be considered a good type of structure.

The method of grading roads by the type of surface has been universally adopted since liberation. Because the road surface is made up of stones of varied sizes, the materials used are placed in the most compact manner, which assures the stability and strength of the road surface. In most parts of our country, there are large supplies of stones of naturally graded sizes, and so this type of surface is a desirable one when need to procure materials locally must be considered.

The greatest defect of both the two above types of road surfaces is that the very top layer is loose and often disintegrates. As the result of experiences and experiments carried out during the past few years, it is very useful to pave on top one layer of sand of from three to five millimeters. This sand layer also affords protection, as it maintains the road surface at a constantly level state and degree of smoothness, and thus greatly prolongs the life of the road. This is a creative great achievement in the maintenance and protection of the transitional types of road surfaces.

We have also carried out a series of studies on the use of lime and cement for the consolidation of earth road surfaces. As proved by practical application, the use of lime or cement for the strengthening of earth as the bed of transitional types of road surfaces or in higher grade road surfaces has been successful. But its defect is that it does not stand long wear and a protective layer must be added. If sand crystals of varied grades are used for the protective layer, the road can also bear a daily traffic of more than 300 vehicles. If asphalt is used, the road can bear a daily traffic volume of from 500 to 1,000 vehicles.

Under existing conditions in China, the road surface of stone tablets and of brick are also types which should be adopted. In areas with a large volume of traffic and where supplies of stone are plentiful, stone slabs should be used for road surfaces. This type not only uses materials procured locally, but its life is also long and maintenance is easy. In the future, when we have better road building materials (such as cement and asphalt), they can be used on top, and the stone

slabs can serve as the foundation or the bottom layer. Studies today should be directed to improvement of the technique of processing stone slabs and the improving of paving operations.

A most important problem today is the construction of all-weather roads in areas which do not produce road construction materials. Of course this problem can be solved with the use of more costly materials, such as cement and asphalt. But we produce these items in very small quantities today, and if we did use them huge investments would be needed. Therefore, during the next two or three years, we must attach importance to the study of utilizing earth obtained locally for firing bricks for road surfaces. Experience has proved that bricks fired from earth obtained along the road can be made to reach a resistance capacity of 600 kilograms per square millimeter, which conforms with the surface strength needed.

When the roads are later reconstructed as high grade or secondary high grade roads, an additional layer may be added, and the original brick road surface may be made the foundation of the bed. The studies today should be directed to further improvement of the quality of bricks, the lowering of costs, and improvement of road surface designing and construction.

Before liberation, we only had about 200 kilometers of macadamized roads, and all the asphalt used was purchased from the capitalist countries. After liberation, with the development of the petroleum and coke industries, there has been a rapid increase of macadamized roads. In the field of organic compounds, we have formulated various draft standards suited to the existing conditions. In the procurement of mineral supplies, apart from the general use of alkaline rocks, we have also used granite, hard rocks and other acid rocks for the construction of macadamized road surfaces. Soft pebbles and broken stones have also been used.

In addition, we have also studied the use of a liquid earth paste (with asphalt, earth and water as its constituents), liquid asphalt, and a mixture of petroleum asphalt and liquid asphalt, as well as natural asphalt in the construction of road surfaces.

In the fields of structure and construction operations, we have used such methods as superficial treatment /surface treatment/, immersion, treatment of earth with asphalt, use of black pebbles and the spraying of liquid asphalt over sand surfaces. We are engaged in a study of the use of locally fired porcelain

pebbles for surfaces that are superficially treated with asphalt or prepared by the immersion treatment in areas where stone pebbles cannot be obtained. Asphalt is a very good road construction material, and with the development of the petroleum and coke industries, macadamized roads will be extensively developed in the future.

After liberation, because of the small production of cement and the limited construction funds, apart from the roads in the cities, few roads have concrete surfaces. In accordance with existing conditions, we are engaged in the study of the utilization of the products of local small cementworks for the construction of cement-concrete road surfaces. Along the Peiping-Tangku Highway we have constructed 17,119 square meters of cement-concrete prefabricated road surface, and after several years of traffic the condition of the road is still very good. With the development of the raw materials industry and communications enterprises, there will be a rapid development of cement-concrete road surfaces.

Our country has an extensive territory, and in recent years we have met with many special problems in highway construction. Along the Tsinghai-Tibet Highway, for instance, we discovered places icebound all year round, and in the Tsaidam Basin we found salt soaked desert areas and salt covered areas. Highway construction problems in these special areas have all been settled satisfactorily.

Adoption of New Techniques in Bridges and Tunnels

Before liberation, few bridges were built and their quality was inferior. Over the larger rivers in the southern areas ferries were mostly used, while in the northern areas traffic was open only in certain seasons. All the bridges constructed were mostly wooden structures, and there were few permanent ones. There were no unified design standards, we lacked blueprints of a national nature, and there was, of course, no drilling and prospecting and investigation of hydrological conditions. In construction, mechanical equipment was lacking and handicraft work was mostly used, so that not only was construction slow but quality was also inferior.

After liberation, in the wake of the development of the highway and communications enterprises, large numbers of bridges were built and there was also great progress in the technical aspects. In the fields of hydrological studies and computation

of spans and lengths, we proceeded from scratch to the point where we now have much knowledge. After the large scale nationwide investigations and studies conducted during the past two or three years, we have gradually progressed to the stage of independent development in combination with the actual conditions in our country.

The wooden bridges of our country have definitely been developed in designing theory and structural form during the past few years. We have not only constructed girder bridges with spans of more than 40 meters, but have also carried out many satisfactory tasks in the use of smaller timber pieces in the construction of longer wooden bridges in order to solve supply difficulties connected with larger pieces of timber. For example, we have built 14-meter spans supported with simple girders, 20-meter spans with nailed girders, 30-meter spans with V shaped girders, and modern spreading support bridges with spans of 12 meters.

In order to better and more rationally utilize small pieces of timber, we are studying the use of plastic materials for bridge building. If this problem is satisfactorily solved, it will be of great significance to the development of wooden bridges. The greatest defect of wooden bridges is their short life. To solve this problem, we have carried out a series of studies on anti-corrosion and anti-pest measures. Satisfactory results have been obtained through applying pastes, immersion and superficial treatment, and the life of wooden bridges has been greatly prolonged.

The bamboo bridge has been a bold experiment in bridge construction in our country. Our country's timber resources are comparatively limited, while the southern areas produce much bamboo. To solve the problem of bridges for local roads and to procure materials locally, we have studied the utilization of bamboo for bridge construction. In 1956 we constructed three experimental bamboo bridges. One bridge (8 meters long) has been tested by traffic over a period of three years, and generally its condition is satisfactory. Such bridges can be a form of bridge structure used in the southern parts of our country. Of course there are still many problems which call for further intensified study and improvement.

Arched bridges of stone have a long history in Chinese architecture. Their good points include the availability of local materials, their durability, low cost of maintenance, great strength and stability, and outward beauty. After lib-

eration, there was a further development in the construction of stone arched bridges, and we have greatly raised their design, theory and construction craft. In 1958 and 1959 especially, the arched stone bridge had a flying leap forward in the scientific and technical field. The spans have not only been increased to 30 to 60 meters, but we also have started to use pebbles and slate in the construction of stone arched bridges on non-rocky foundations. This structural form should be greatly advocated and developed in China today when there is a lack of steel materials and cement. The direction of our future studies in this field is the intensified promotion of design theory, and of technique used in girder building and general construction.

During the past 10 years we have built many reinforced concrete bridges. We also have made rapid development in design theory, structural forms and construction techniques. In addition to the construction of many cantilever bridges and suspension bridges, we have recently started to design and construct prefabricated concrete bridges, reinforced concrete box girder bridges, prefabricated reinforced concrete arched bridges, and prefabricated reinforced concrete lattice girder bridges. The pre-stressed reinforced concrete bridge is a new advanced structural form, which not only uses less steel but also calls for less deflection, does not crack and is of high quality. All this greatly affects the life of the bridge. We have designed blueprints for various bridges with spans of from 20 to 50 meters, and various places are adopting these designs.

More than 1,000 years ago, our country created the chain type of bridge. Though it could only be used for pedestrians, under conditions then existing, the technique must be considered very excellent. After liberation, in order to solve the great lack of communications facilities in the southwest, we constructed many hanging chain bridges of the slanting type and hanging chain bridges with strengthened trusses. In the southwestern region of the country there are many tall mountains, narrow ravines, swift streams and deep rivers and the construction of such types of bridges has its definite place of superiority.

We have also made rapid progress in the past few years in the techniques of constructing bridge buttresses, bases and foundations. In the matter of buttresses, in addition to a concrete body built around rocks, we also often use two-column buttresses, single column buttresses, such new type buttresses as prefabricated and thin layer ones. Bases used include the

U-shaped base, the concealed base and the rib-shaped H shaped base.

For the foundation, we have often used natural terrain as well as the box caisson method, the column foundation, and a foundation consisting of sand and pebbles constructed with manpower. In the field of column foundations, the most prominent achievement has been the adoption and development of the high column platform method, and we have accumulated considerable experiences in use of the hydraulic caisson. The driving of piles expanded after driving vertically can generally increase the load capacity by 50 to 100 percent. The method of hydraulic pile driving can greatly economize the process of driving piles. If both these methods will lead to satisfactory results, the foundation work will not only greatly reduce engineering costs but also will greatly shorten the construction time.

Small bridges and tunnels are needed in large quantities on highways. If production costs can be lowered, they will greatly affect the cost of highways. During the past few years we have given sufficient attention to this, and have continually summarized experiences and continually carried out technical renovations. In accordance with the different needs of highways, in addition to the general reinforced concrete tunnels, we have also adopted the lime type of concrete tunnel, the uncovered tunnel, the lime-concrete arched tunnel, the stone slab tunnel, the brick-arched tunnel, the porcelain tunnel and the tile tunnel.

We have also adopted a light cover for bridges and the four outlet tunnel, all advanced structural forms. On the top of the tunnel cover, the single opening has been developed into many openings. The bottom is supported by stones in place of reinforced concrete, and the top is wood instead of reinforced concrete. And, bridge surfaces are composed of large pebbles instead of slabs. Through these techniques we have achieved comparatively satisfactory results.

The use of glass in concrete in place of reinforced concrete in the construction of bridges and tunnels has only been developed in the past few years. The replacement of steel reinforced concrete with glass not only economizes on large quantities of steel products, but also has the superior points of light weight, is stain and corrosion-proof, and simplicity of production. We have started the study of this and are prepared to trail construct some to facilitate observation and improvement.

Raise High the Red Banner of the General Line

and Continue the March Forward

Summing up the above, in the short space of 10 years, we have achieved colossal results and a flying development in highway technique and science. This is primarily due to the wise leadership of the Party. The Party, in accordance with the development of the general situation, has from time to time decided policies and measures and the direction along which efforts are to be exerted.

Next comes the creative labor of the broad masses. Without the vigorous mass movement for technological revolution, it would have been impossible to push forward at such a flying speed highway technique and science.

Of course, the superiority of our socialist system has provided the decisive factor for the flying development of science and technique. The selfless help obtained from the Soviet Union and other fraternal countries has also been an indispensable factor contributing to the flying leap forward of our highway technique and science.

At a time when we celebrate the Tenth Anniversary of the founding of the great Chinese People's Republic, and as we review the flying development of our highway technique and science, we have all the more confidence in following the general line for building socialism through the exertion of our utmost efforts, and to press forward consistently to achieve greater, faster, better and more economical results as pointed out by the Party. Let us lead our highway technique and science to a greater leap forward, to a greater victory.

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